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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/552,126	10/05/2005	Takuya Satoh	10873.1781USWO	6348

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EXAMINER	
TAI, XIUYU	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
04/16/2008	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/552,126	SATOH ET AL.	
	Examiner	Art Unit	
	Xiuyu Tai	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 October 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-3,5-7,9 and 11-13* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,5-7,9 and 11-13* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *05 October 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date *10/5/2005 & 8/4/2006*.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 1-3, 5-7, and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Negami et al (U.S. 6,259,016) in view of Contreras et al (“High Efficiency Cu(In, Ga)Se_2-Based Solar Cells: Processing of Novel Absorber Structure”, First WCPEC; Dec. 5-9, 1994,P 68-75) and in further view of Banda et al (WO 03/043096).

5. Regarding claim 1, Negami et al disclose a solar cell. The solar cell comprises: (1) a first electrode layer 12 (Figure 1; col. 5, line 5); (2) a second electrode layer 15 (Figure 1; col. 5, line 8); (3) a p-type semiconductor layer 13 interposed between the first and the second electrode layer (Figure 1; col. 5, line 6 & 17-19); and (4) a n-type semiconductor layer 14 interposed between the p-type semiconductor layer and the second electrode layer (Figure 1; col. 5, line 7 & 35-37). Negami further teaches that a Cu(In, Ga)Se_2 film that has a chalcopyrite structure is used as the semiconductor layer 13 (col. 8, line 65-67).

6. With respect to band gap in claim 1, it varies with the components of semiconductor. As taught by Negami, a Cu(In, Ga)Se_2 film is used as a light-absorb layer having a band gap of about 1.2 eV (col. 8, line 65-67) and a CdS film is used a window layer having a band gap of about 2.4 eV (col. 7, line 23-27 & 35-40). In this case, a band gap between a Cu(In, Ga)Se_2 film (i.e. p-type semiconductor layer) and a CdS film (i.e. n-type semiconductor layer) is about 1.2 eV and a band gap between a Cu(In, Ga)Se_2 film (i.e. p-type semiconductor layer) and a Mo metal film (i.e. first electrode layer. col. 5, line 15-16) is about 1.2 eV.

7. Negami fails to the p-type semiconductor comprising a first region and a second region. However, Contreras et al disclose a high efficiency Cu(In, Ga)Se_2-Based Solar Cell that is engineered a higher Ga content toward the back of the CIGS absorber (Figure 9b, page 71 the third paragraph). Contreras further teaches that the higher Ga content found toward the back gives the wider bandgap composition, hence better conversion efficiency (page72 the first paragraph & abstract). The absorber layer of Contreras can be divided as a higher Ga content region and a lower Ga content region. Therefore, it would be obvious for one having ordinary skill in the art to engineer a higher Ga content toward back of the light-absorbing layer as taught by Contreras in the device of Negami in order to enhance the conversion efficiency.

8. For the changing rate of the bandgap in the different regions, Banda et al define the gradient (slope) of the bandgap as the rate of change in the band energy with respect to the thickness as is well known in the art (page 32, line 8-15). In the first region, the changing rate of bandgap is determined by the bandgap and the thickness of the first region as defined by Banda. Since the bandgap can be controlled by changing the Ga content in the absorber layer as taught by Contreras, one having ordinary skill in the art would have find obvious to adjust the components of the semiconductor layer and/or the thickness in the second region in order to optimize the bandgap changing rate, achieving a better conversion efficiency of the solar cell.

9. Regarding claim 2, in the teaching of Negami, a Cu(In, Ga)Se_2 film is used as a light-absorb layer having a band gap of about 1.2 eV (col. 8, line 65-67) and a CdS film is used a window layer having a band gap of about 2.4 eV (col. 7, line 23-27 & 35-40).

In this case, a band gap between a $Cu(In, Ga)Se_2$ film (i.e. p-type semiconductor layer) and a CdS film (i.e. n-type semiconductor layer) is about 1.2 eV, reads on “a band gap of the p-type semiconductor layer on the main surface at the n-type semiconductor layer is at least 1.2 eV" as claimed.

10. Regarding claim 3, a band gap between a $Cu(In, Ga)Se_2$ film (i.e. p-type semiconductor layer) and a Mo metal film (i.e. first electrode layer. col. 5, line 15-16) is about 1.2 eV when a $Cu(In, Ga)Se_2$ film is used as a light-absorb layer having a band gap of about 1.2 eV (col. 8, line 65-67) in Negami’s cell. Moreover, Negami further indicates that in the case of the solar cell including CIGS fillm, it is possible to control the band gap by changing the ratio of Ga and In. Therefore, one having ordinary skill in the art would have found obvious to adjust components of semiconductor in order to optimize the band gap to achieve better conversion efficiency of a solar cell.

11. Regarding claim 5, Negami teaches a $Cu(In, Ga)Se_2$ film as the semiconductor layer 13 (col. 8, line 65-67), reads on “ the group Ib element is Cu, the group IIIb element is at least one element selected from the group consisting of In, Ga, and Al, and the group VIb element is at least one element selected from the group consisting of Se and S" as claimed.

12. Regarding claim 6, the absorber layer of Contreras is engineered a higher Ga content toward the back of the CIGS absorber (Figure 9b, page 71 the third paragraph). Therefore, it would be obvious for one having ordinary skill in the art to engineer a higher Ga content toward back of the light-absorbing layer as taught by Contreras in the device of Negami in order to enhance the conversion efficiency.

13. Regarding claim 7, Negami fails to teach the p-type semiconductor having an increasing Ga ratio from the n-type semiconductor layer side to the first electrode layer side. However, Contreras et al disclose a high efficiency Cu(In, Ga)Se_2-Based Solar Cell that is engineered a higher Ga content toward the back of the CIGS absorber (Figure 9b, page 71 the third paragraph). Contreras further teaches that the higher Ga content found toward the back gives the wider bandgap composition, hence better conversion efficiency (page72 the first paragraph & abstract). Therefore, it would be obvious for one having ordinary skill in the art to engineer a higher Ga content toward back of the light-absorbing layer as taught by Contreras in the device of Negami in order to enhance the conversion efficiency. As is well known in the art, the gradient (slope) of the ratio is defined as the rate of change in the ratio number with respect to the thickness. In the first region, the changing rate of ratio is determined by the ratio number and the thickness of the first region. Since the ratio number can be controlled with the method as taught by Contreras, one having ordinary skill in the art would have find obvious to adjust the Ga content and/or the thickness of the second region in order to optimize the ratio changing rate, achieving a better conversion efficiency of the solar cell.

14. Regarding claims 11-13, Negami indicates that the conversion efficiency is reduced when the ratio of Ga/(Ga + In) is higher than 0.5 (col. 6, line 54-64). As taught by Contreras, the higher Ga content found toward the back gives the wider bandgap composition, hence better conversion efficiency (page72 the first paragraph & abstract). Therefore, it would be obvious for one having ordinary skill in the art to provide a p-type

semiconductor layer with a lower ratio of Ga on the main surface of n-type semiconductor layer side and a higher ratio of Ga on the main surface of the first electrode layer side as taught by Contreras while maintain a ratio of Ga lower than 0.5 within the p-type semiconductor layer in the device of Negami in order to improve the conversion efficiency of a solar cell.

15. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Negami et al (U.S. 6,259,016) in view of in view of Contreras et al and in further view of Takeshi et al (JP 11274526).

16. Regarding claim 9, Negami/Contreras fail to teach a solar cell comprising Al. However, Takeshi et al disclose a semiconductor thin film with CIS-based chalcopyrite structure comprising Cu (In_z, Al_{1-z}) Se2 (paragraph (0012) of [Means for solving the problem]). The reference also indicates that Al content continuously changes toward the back of the CIS film (Abstract; paragraph (0017) of [Means for solving the problem]). Takeshi further teaches that the change of Al content toward the back varies the bandgap of semiconductor (paragraph (0011) of [Means of solving the problem]). Therefore, it would be obvious for one having ordinary skill in the art to engineer a change of Al content toward back of the light-absorbing layer as taught by Takeshi in the device of Negami/Contreras in order to enhance the conversion efficiency. As is well known in the art, the gradient (slope) of the ratio is defined as the rate of change in the ratio number with respect to the thickness. In the first region, the changing rate of ratio is determined by the ratio number and the thickness of the first region. Since the ratio number can be controlled with the method as taught by Takeshi, one having

ordinary skill in the art would have find obvious to adjust the Al content and/or the thickness of the second region in order to optimize the ratio changing rate, achieving a better conversion efficiency of the solar cell.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Xiuyu Tai whose telephone number is 571-270-1855. The examiner can normally be reached on Monday - Friday, 7:30 AM - 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/X. T./
Examiner, Art Unit 1795

/Alexa D. Neckel/
Supervisory Patent Examiner, Art Unit 1795